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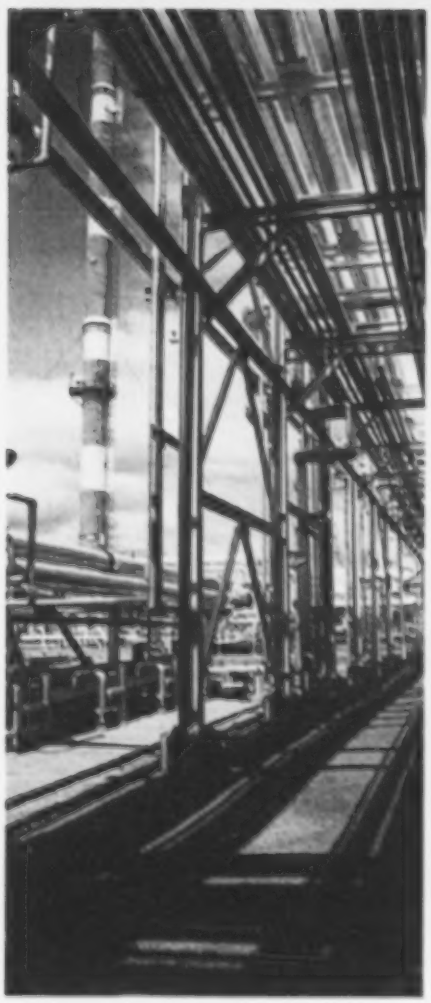
FOCUS ON
SAFETY AND ENVIRONMENT
A COMPARATIVE ANALYSIS OF PIPELINE PERFORMANCE
2000-2006



JULY 2008

Canada

National Energy Board

Office national de l'énergie

Focus on Safety and Environment

A Comparative Analysis of Pipeline Performance

2000–2006

July 2008

Canada

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LIST OF ACRONYMS AND ABBREVIATIONS

BLS	United States Department of Labor - Bureau of Labor Statistics
CAPP	Canadian Association of Petroleum Producers
CLC Part II	Canada Labour Code Part II – Occupational Health and Safety
COGOA	National Energy Board activities regulated under the Canada Oil and Gas Operations Act
CONCAWE	European Oil Companies Association for Environment, Health and Safety
CSA	Canadian Standards Association
EGIG	European Gas Pipeline Incident data Group
ERCB	Energy Resources Conservation Board (formerly Alberta Energy and Utilities Board)
FTE	Full-time Equivalent
HRSDC	Human Resources and Skills Development Canada
LWC or LWDC	Lost Workday Case
NAICS	North American Industry Classification System
NEB	National Energy Board
NGL	Natural Gas Liquids
OGP	International Association of Oil and Gas Producers
OPR-99	Onshore Pipeline Regulations, 1999
PHMSA	Pipeline and Hazardous Materials Safety Administration
PLCAC	Pipe Line Contractors Association of Canada
RWC or RWDC	Restricted Workday Case

FOREWORD

This report, *Focus on Safety and Environment: A Comparative Analysis of Pipeline Performance, 2000-2006*, examines the number and frequency of various incidents that affect pipeline safety, integrity and the environment. The main objective of this report is to evaluate the pipeline performance of NEB-regulated companies over time and in comparison to pipeline performance in other jurisdictions.

The first of the NEB's annual performance indicators reports, *Focus on Safety: A Comparative Analysis of Pipeline Safety Performance*, was published in April 2003. This sixth edition of the report includes data from 1 January 2000 through 31 December 2006.

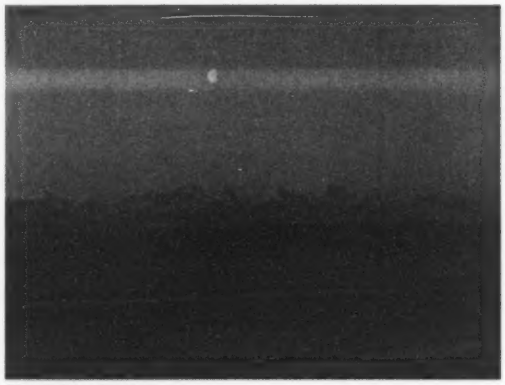

Photo by Marc Pauzé

The NEB continually seeks input and feedback from stakeholders on the value of this report and ways it can be improved. Any comments or questions pertaining to this report should be directed to:

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EXECUTIVE SUMMARY

There are hundreds of thousands of kilometres of pipe in Canada, more than 45,000 kilometres of which are regulated by the National Energy Board. Our role is to promote pipeline safety – safety for the workers, safety for the environment and safety for Canadians.

One of the ways the National Energy Board promotes pipeline safety is to ask the 104 companies we regulate to share their performance data on occupational injuries, hours of work, and leaks and spills. The NEB analyzes this data and uses it to develop performance indicators. These indicators are used to identify trends within the industry as well as to evaluate a company's individual performance compared to the industry average. In addition, the indicators are used by the NEB to help develop operation compliance plans. These plans help the NEB to assign its compliance verification resources where they are most needed. These indicators suggest that pipelines remain a safe method of moving the vast amount of energy Canadians need to heat our homes, fuel our vehicles and power our economy.

The Board uses eight key indicators to evaluate how well NEB-regulated companies are performing in the areas of worker safety, integrity management programs and protecting the environment. These performance indicators and the Board's findings for 2006 are listed below:

- **Number of Fatalities**

  For the ninth consecutive year, there were no fatalities on NEB-regulated pipelines in 2006.

- **Number of Pipeline Ruptures**

  2006 was the fourth year in a row with no ruptures on NEB-regulated oil and gas pipelines. Since the requirement to implement pipeline integrity management programs was introduced by the NEB in 1999, the rupture frequency rate has dropped from 2.7 ruptures annually from 1991 to 1999 to 0.85 ruptures annually from 2000 to 2006.

- **Number of Injuries**

  Injuries were on the rise in 2006. The annual injury frequency for employees working on pipelines more than doubled to 1.5 injuries for every 100 full-time employees. For the first time in seven years, the annual injury frequency for regular company employees was nearly identical to the annual injury frequency for contractors.

- **Number of Pipeline Contacts**

  There was one contact and 65 unauthorized activities on NEB-regulated pipelines in 2006. While the number of pipeline contacts is below the 2000 to 2006 average of 1.4 pipeline contacts annually, the number of unauthorized activities is above the seven-year average of 51. The growth of urban areas and new developments near pipelines increases the

likelihood of unauthorized excavations or other disturbances that can damage the pipeline.

- **Number of liquid releases, leaks and spills *and* Volume and Frequency of liquid releases, leaks and spills**

  The number of spills on liquid pipelines rose to 161 from 101 in 2005 and the number of releases greater than 1 500 litres increased from 6 to 11 occurrences in 2006. However, the total volume of petroleum products involved in these incidents was very low and dropped below 2005 volumes.

- **Number and frequency of gas releases**

  Over the past seven years, there has been about one pipe body release for every 14 300 kilometres of gas pipelines. Operational gas leaks, or leaks from non-gas pipe body sources, are about ten times more likely than leaks caused by the failure of the pipe body.

- **Number of NEB reportable incidents under the OPR-99**

  NEB-regulated companies are legally required to report certain incidents to the Board, such as a serious injury or an unintentional pipeline release. These incidents are defined in the OPR-99. In 2006, there were 37 incidents and the most common reportable incident was an unintended gas release.

This report uses the data and accompanying analysis to provide the National Energy Board with some of the information used to prioritize the Board's compliance verification activities, such as audits and inspections. Safety, integrity and the environment have been an integral part of the NEB's mandate for nearly 50 years. The NEB is concerned about the rising number of injuries identified in this year's report and will continue to track these issues and work closely with industry to improve workplace safety. Through active participation in standards development, pipeline research, and awareness programs, as well as partnerships with other regulators, the NEB is actively involved in promoting safety and environmental protection.

The NEB is committed to maintaining a high level of vigilance over all aspects of pipeline activities.

TABLE 1

Performance Indicator Comparison*

Performance Indicator	2005	2006	Historical Average 2000 – 2006
Number of Fatalities (employee, contractor and third-party)	0	0	0
Worker Injury Frequency (injuries per 200 000 hours)	0.7	1.5	1.0
Contractor Injury Frequency (injuries per 200 000 hours)	1.1	1.6	2.2
Employee Injury Frequency (injuries per 200 000 hours)	0.6	1.5	0.6
Liquid Pipeline Worker Injury Frequency (injuries per 200 000 hours)	0.9	1.6	1.5
Gas Pipeline Worker Injury Frequency (injuries per 200 000 hours)	0.7	1.5	0.9
Total Number of Pipeline Ruptures	0	0	0.9
Total Number of Pipeline Contacts	1	1	1.4
Pipe Body Liquid Release Frequency (number of liquid releases per 1 000 km)	0.1	0.3	0.1
Pipe Body Liquid Release Volume Frequency (m^3 of liquid released per 1 000 km)	17.8	2.5	35.7
Number of Operational Liquid Leaks (on liquid pipelines)	51	38	43.6
Operational Liquid Leak Frequency (number of leaks per 1 000 km liquid pipelines)	3.1	2.6	2.8
Pipe Body Gas Release Frequency (number of gas releases per 1 000 km gas pipelines)	0.1	0.0	0.1
Number of Operational Gas Leaks (on gas pipelines)	19	21	18.1
Operational Gas Leak Frequency (number of leaks per 1 000 km gas pipelines)	0.7	0.7	0.7
Number of Non-pipeline Spills (consruction & maintenance liquid spills)	48	124	81
Total Number of Incidents (reportable OPR-99)	39	37	37.6

* See Glossary for definitions of performance indicators.

INTRODUCTION

1.1 The National Energy Board

The NEB regulates 104 oil, gas, and product pipeline companies that operate approximately 45 000 kilometres of pipelines across Canada under the *Onshore Pipeline Regulations, 1999* (OPR-99). This network includes large diameter (up to 42 inches in diameter), high-pressure natural gas pipelines, crude oil and oil products pipelines, as well as small-diameter pipelines (typically 4 to 12 inches in diameter), and a number of commodity pipelines.

The NEB's purpose is to promote safety, security, environmental protection and efficient energy infrastructure in the Canadian public interest within the mandate set by Parliament in the regulation of pipelines, energy development and trade.

The NEB has additional regulatory responsibilities under the *Canada Oil and Gas Operations Act* (COGOA) for oil and gas exploration and production activities in the North (excluding the Yukon) and in those offshore areas that are not subject to a federal-provincial shared management agreement. Some data from COGOA-regulated activities are included in this report for comparison purposes.

Photo by Marc Pauzé

Other aspects of the NEB's mandate include the regulation of gas plants under the Processing Plant Regulations and some international and inter-provincial power lines. Along with Natural Resources Canada, the NEB plays a leading role in ensuring the effective functioning of energy supply systems in Canada. It has also been responsible for the security of Canada's federal energy infrastructure since 2005.

For the purpose of comparison throughout this report, the term "pipeline" includes: all branches, extensions, tanks, reservoirs, storage facilities, pipes, pumps, valves, racks, compressors, storage tanks and loading facilities integral to the operation of a hydrocarbon pipeline. The performance data in this report is for natural gas and liquid hydrocarbon pipelines only. Commodity pipelines, gas plants, power lines and security information is not reported upon in the NEB's Focus on Safety and Environment report.

1.2 Performance Indicators

Performance indicators provide information on trends and are used by industry and government to assess performance over time and relative to other sectors. Industry trends and benchmarking

comparisons can provide valuable insight into the effectiveness of safety, integrity and environmental management systems. The NEB uses performance indicators to improve regulatory compliance monitoring programs by identifying areas where more vigilant oversight is needed as well as areas where less oversight may be justified.

1.2.1 *Safety, Integrity and Environment*

This report presents information on eight performance indicators which are used to evaluate: i) the safety of pipeline workers - including both employees and contractors, ii) the effectiveness of pipeline integrity programs, and iii) the protection of the environment.

The performance indicators reported upon are:

- number of fatalities;
- number of injuries;
- number of pipeline ruptures;
- number of pipeline contacts;
- number of liquid releases, leaks and spills;
- volume and frequency of liquid releases, leaks and spills;
- number and frequency of gas releases; and
- number of NEB reportable incidents under the OPR-99.

1.2.2 *Reporting*

The data in this report was obtained through both voluntary reporting and the OPR-99's mandatory reporting requirements. In August 2007, the NEB sent a letter to all its NEB Act regulated companies requesting their voluntary 2006 performance data regarding: Occupational Injury and Hours of Work (for both employees and contractors), Company Employee Safety Training Hours, and Leaks and Spills. Although not all companies submitted the requested data, companies representing approximately 98 per cent of the total length of NEB-regulated pipelines have provided their data.

It is important to note that company participation in this initiative is vital. Without full participation, it is difficult to make conclusions that are representative of the entire Canadian pipeline industry. The analysis of the voluntary data helps both the Board and the companies it regulates to better understand safety, integrity and environmental performance. Appendix A3 provides a list of companies who have voluntarily reported for 2006 and outlines the pipeline kilometres reported upon every year.

Photo by Kim Maddin

1.3 Reference Organizations

Where similar data is available, this report provides a comparative analysis of NEB performance indicators with that of other organizations. The external data is based mainly on publicly available documents provided on websites and in published reports. In some cases, specific data were acquired through direct correspondence with the reference organizations. The following organizations have been selected for comparison:

- **BLS**: United States Department of Labor – Bureau of Labor Statistics;
- **CAPP**: Canadian Association of Petroleum Producers;
- **COGOA**: National Energy Board activities regulated under the *Canada Oil and Gas Operations Act*;
- **CONCAWE**: European Oil Companies Association for Environment, Health and Safety ;
- **EGIG**: European Gas pipeline Incident data Group;
- **ERCB**: Energy Resources Conservation Board;
- **HRSDC**: Human Resources and Skills Development Canada;
- **OGP**: International Association of Oil and Gas Producers.
- **PHMSA**: United States Department of Transport – Pipeline and Hazardous Material Safety Administration – Office of Pipeline Safety; and,
- **PLCAC**: Pipe Line Contractors Association of Canada.

Detailed information on these reference organizations including web addresses and data sources are listed in Appendix A1.

ANALYSIS OF PIPELINE PERFORMANCE

2.1 Fatalities

Fatalities have an immediate and devastating effect on families, communities, companies and the industry as a whole. They may also act as a catalyst for changes to legislation, regulations, industry codes and standards.

Fatality data provided by NEB-regulated companies have been separated into three categories:

1. Employee Fatalities

   These are fatalities that occur while an employee is involved in activities associated with their job duties. Employee data from NEB-regulated pipelines do not include head office staff but do include staff from other facility offices.

2. Contractor Fatalities

   These are fatalities that occur while a contract worker is involved in activities pursuant to their contract with a pipeline company. Contractor data include contractors performing activities related to the construction, operation, or maintenance of NEB-regulated pipelines.

3. Third-party Fatalities

   These are fatalities involving persons other than contractors or employees.

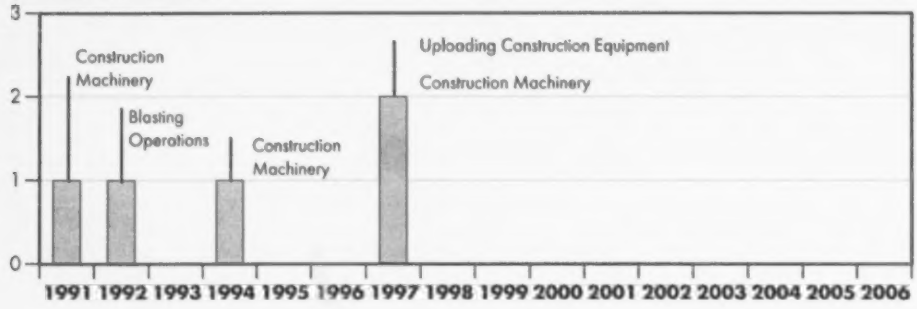
Figure 2.1 shows the number and cause of all reported fatalities on NEB-regulated pipelines since 1991. The year 2006 is the ninth consecutive year in which there have been no fatalities on

Photo by Karen Duckworth

FIGURE 2.1

NEB-Regulated Pipeline Fatalities

Number of Fatalities



NEB-regulated pipelines.[1] The fatalities reported between 1991 and 1997 were contractor fatalities and involved construction activities. Since 1997, several hundred kilometres of new pipelines have been constructed and existing pipelines expanded without any fatalities.

2.2 Injuries

The pipeline industry when compared to other transportation and energy industries continues to exhibit an enviable safety record. Statistics published by HRSDC, for industries under Canadian federal jurisdiction, for 2005 indicate that only banking has a lower injury frequency than pipelines.

Photo by Karen Duckworth

For this report, injury data submitted by NEB-regulated companies have been separated into three categories:

1. Employee Injuries

   These are injuries that occur while an employee is involved in activities associated with their job duties. Employee data from NEB-regulated pipelines do not include head office staff but do include staff from other facility offices.

2. Contractor Injuries

   These are injuries that occur while a contract worker is involved in activities pursuant to their contract with a pipeline company. Contractor data include contractors performing activities related to the construction, operation, or maintenance of NEB-regulated pipelines.

3. Worker Injuries

   These are a combination of the above two categories: employee and contractor injuries.

1 In 2005, a fatality did occur on a NEB-regulated pipeline construction site; however, it was determined that the fatality was not work related but was the result of a medical condition.

Employee, contractor, and worker injury frequencies for NEB-regulated pipelines from 2000 to 2006 are reported both under the OPR-99 and voluntarily, as such this data includes all lost time and restricted workday injuries but excludes fatalities. All injury frequencies are measured in terms of injuries per 200 000 hours of work. The 200 000 hours of work is a widely used frequency denominator in the health and safety industry and is equivalent to the number of hours worked by 100 full-time equivalent employees (FTEs) in one year.

As shown in Figure 2.2 the worker injury frequency has increased from 0.72 injuries per 200 000 hours in 2005 to 1.55 in 2006, with an overall seven year average of 1.02 injuries per 200 000 hours for all workers. In 2006, for the first time since the inception of this report, the injury frequency reported for employees matched very closely with the injury frequency reported for contractors. At this time, the unprecedented high levels of employee injuries cannot be explained. Factors such as: increased activity, the level of experience of employees, the complexity of the work being undertaken, the lack of resources (resulting in overtime), inadequate training, as well as poor hazard assessment programs may contribute to the high frequency observed in 2006.

FIGURE 2.2

Injury Frequency Comparisons for NEB-Regulated Pipelines

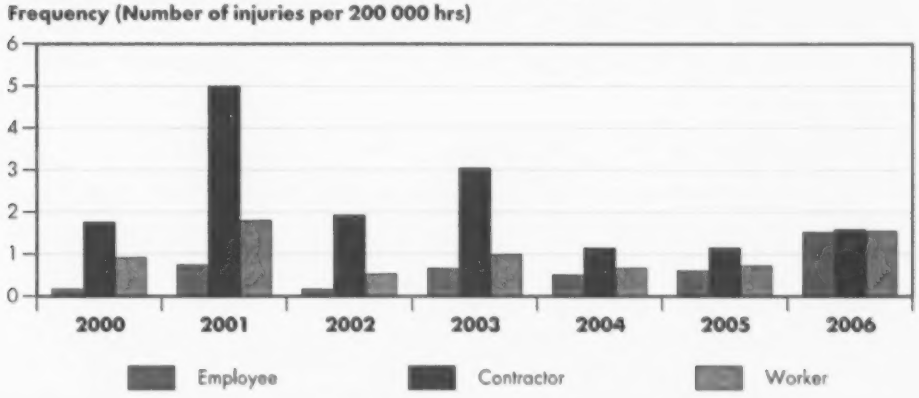
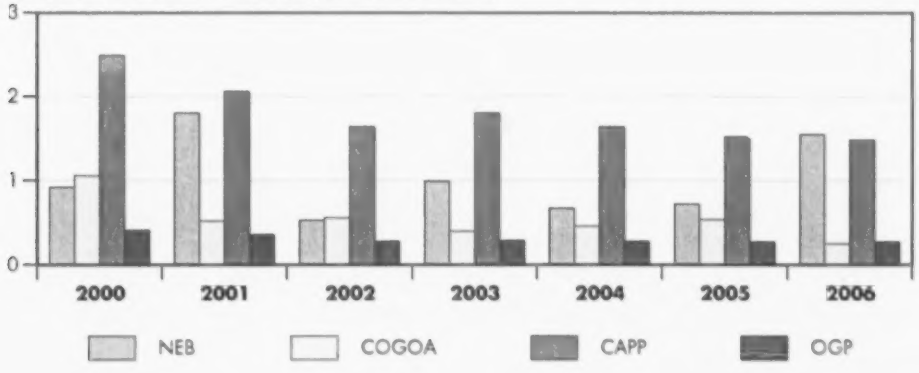


FIGURE 2.3

Worker Injury Frequency Comparisons



Injury Frequency Comparisons

Figure 2.3 compares the NEB-regulated pipeline worker injury frequency to the same parameter for COGOA , CAPP and OGP from 2000 to 2006.

The worker injury frequency for NEB-regulated pipelines tends to be higher than that of COGOA-regulated activities and this trend continued in 2006. For the first time since this report's inception, the worker injury frequency for NEB-regulated pipelines is higher than that reported by CAPP in 2006. Also of note is that CAPP data has shown a downward trend since 2000. The OGP have shown very consistent injury frequencies over the last five years, in contrast to NEB-regulated pipelines which have shown an increasing trend in injury frequencies in the last three years.

Table A2.2 in Appendix A2 is a summary of injury definitions used by the NEB and the reference organizations. Generally, all definitions reflect either the inability of a worker to report to work the next day or from effectively performing all of their regular work duties. A summary of employee and contractor hours and the number of injuries incurred since 2000 is provided in Table A3.2 of Appendix A3.

2.2.1 *Detailed Injury Analysis*

To better understand reported injury frequencies, the data is further broken down into contractor and employee injury frequencies, contractor serious injury types and causes, and non-compliances observed by the NEB on construction projects. Some of the injury data are further separated into liquid and gas pipeline-related injuries to enable analysis of injury data by sector.

NEB-Regulated Liquid Pipeline Injuries

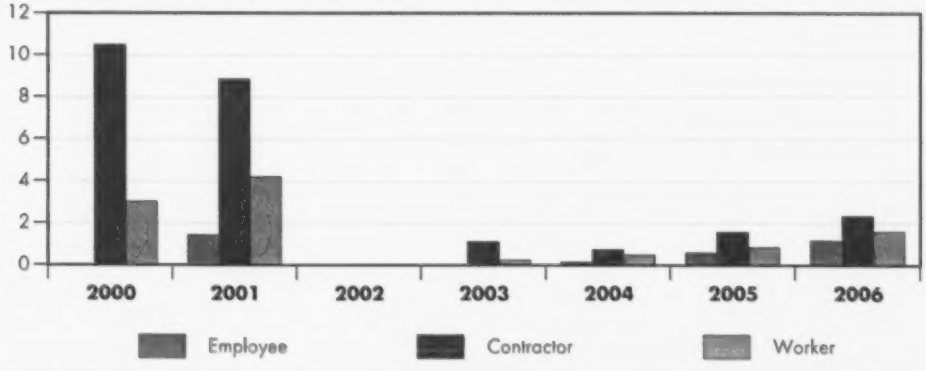
Liquid pipelines include crude oil, refined product and NGL pipelines. Figure 2.4 shows the contractor, employee and worker injury frequencies for NEB-regulated liquid pipelines. Note that in 2002, there were no contractor or employee injuries reported.

The liquid pipeline contractor injury frequency in 2006, 2.34 injuries per 200 000 hours, increased to the highest reported level in 5 years, although it is still lower than the seven year average of 3.58. The liquid pipeline employee injury frequency in 2006 also experienced an increase to the highest levels reported in 5 years.

FIGURE 2.4

NEB-Regulated Liquid Pipeline Injury Frequency

Frequency (Number of injuries per 200,000 hrs)



NEB-Regulated Gas Pipeline Injuries

Figure 2.5 shows the contractor, employee and worker injury frequencies for NEB-regulated gas pipelines.

The gas pipeline contractor injury frequency in 2006, 1.3 injuries per 200 000 hours, increased slightly from the levels reported in 2004 and 2005, although it is lower than the seven year average of 2.1. The gas pipeline employee injury frequency in 2006 exhibited an increase to the highest levels reported in 7 years. Moreover, for the first time since this report's inception, the reported employee injury frequency is higher than that of contractors.

Employee Injury Frequency Comparisons

Figure 2.6 compares the NEB-regulated pipeline employee injury frequency to the same parameter for reference organizations for the period of 2000 to 2006.

NEB-regulated pipeline companies showed a marked increase in the number of employee injuries between 2005 and 2006, while the CAPP frequency decreased and the BLS frequency remained essentially the same. As discussed in Table A2.2 of Appendix A2, industry classifications for the U.S.

FIGURE 2.5

NEB-Regulated Gas Pipeline Injury Frequency

Frequency (Number of injuries per 200 000 hrs)

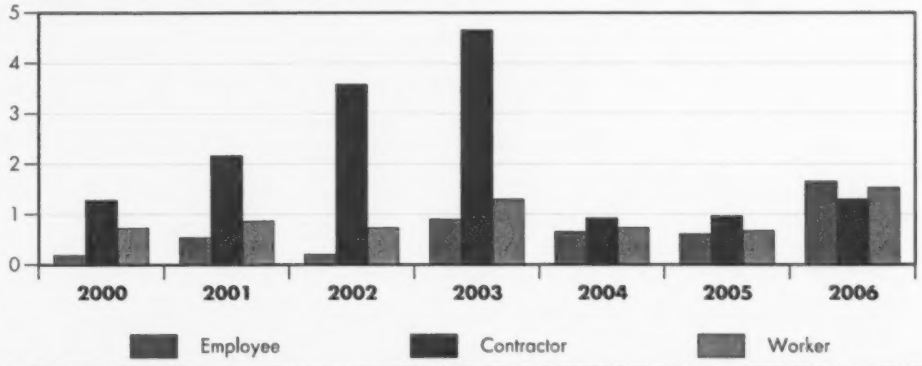
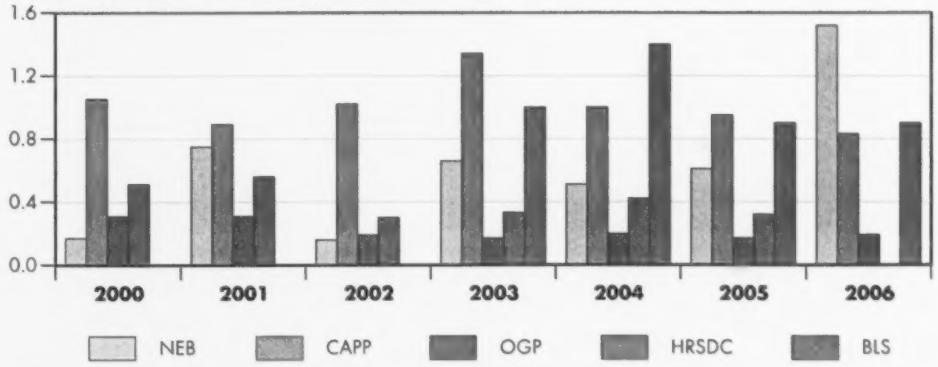


FIGURE 2.6

Employee Injury Frequency Comparisons

Frequency (Number of Injuries per 200 000 hours)



Bureau of Labor Statistics (BLS) were changed in 2003 rendering the 2003 to 2006 injury data for the U.S. pipeline transportation industry comparable to employee data from NEB-regulated pipelines. As such, BLS data for 2002 and earlier are not included in Figure 2.6.

Human Resources and Skills Development Canada (HRSDC) also publishes employee injury frequency data, which include disabling injuries to employees working in head and regional offices, while NEB-regulated pipeline employee injury data do not. However, the HRSDC employee injury frequency for 2000 to 2005[2] ranged from 0.3 to 0.56 injuries per 200 000 hours, a similar range to the NEB frequencies for those years.

Contractor Injury Frequency Comparisons

Figure 2.7 compares the NEB-regulated pipeline contractor injury frequency to the same parameter for the reference organizations for the period of 2000 to 2006. In order to report injury frequencies, a PLCAC member company must report on at least 50 000 contractor hours. PLCAC member companies did not meet this threshold for 2003 through 2005. As a result of the low number of hours worked by PLCAC member companies on pipelines in 2006, the injury frequency data for that year may not be appropriately represented.

The injury frequency rate for contractors working on NEB-regulated pipelines is on average very similar to other organizations. The NEB seven-year average indicates that two out of 100 contractors sustain serious injuries, as defined by the OPR-99, every year.

Contractor Serious Injuries

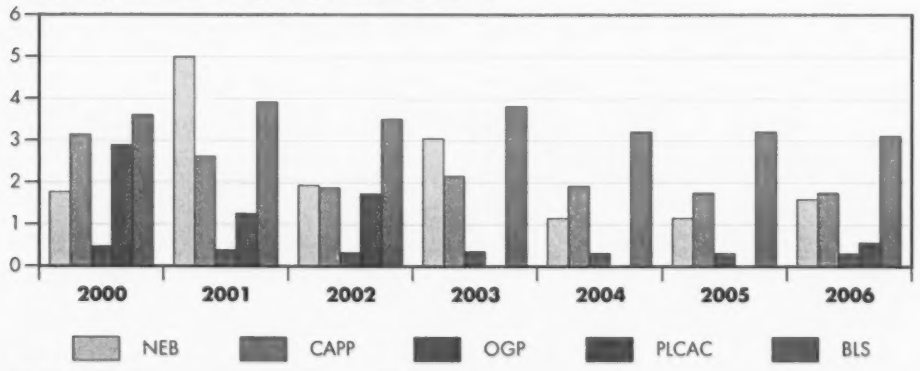
Table 2.1 provides a summary of the types of serious injuries incurred by contractors on NEB-regulated pipelines between 2000 and 2006 that were reported pursuant to the OPR-99. A definition of serious injuries, as defined by the OPR-99, is presented in Table A2.2 in Appendix A2. There were no serious injuries reported in 2002.

The NEB has conducted further analysis on the causes of OPR-reportable incidents, particularly in relation to contractors. The results of the analysis are presented in Table 2.2. The NEB is aware that the historic contractor injury frequency is on average significantly higher than employee

FIGURE 2.7

Contractor Injury Frequency Comparisons

Frequency (Number of Injuries per 200 000 hours)



2 2006 data is not yet available.

TABLE 2.1

OPR-99 Contractor Serious Injuries (2000-2006)

Type of Event or Exposure	Number of Serious Injuries
Contact with Objects & Equipment	
Struck by Object	5
Caught in Object	3
Struck against Object	1
Contact with Electricity	2
Other	0
Falls	
Fall on Same Level	0
Fall to Lower Level	2
Other	0
Transportation Accidents	1
Fire and Explosions	0
Total Number of Serious Injuries	14

frequency. The Board believes that injury frequencies within employee and contractor populations should be similar. The frequency of hazard exposure among contractors may be greater than for employees but protective measures should be designed to mitigate the increased risks.

Contractor serious injury causes are separated into direct (or immediate) and basic (or underlying) causes.

Construction Safety Inspections

As part of its activities to monitor compliance with the OPR-99 and other safety regulations, the NEB regularly inspects pipeline construction projects. The safety non-compliances observed during inspections are most often corrected immediately on-site.

TABLE 2.2

Contractor Serious Injury Causes (2000-2006)*

Direct Causes		2000	2001	2002	2003	2004	2005	2006	Total
Substandard Acts	Improper position for task		1			1			2
	Improper placement	1	1		1			1	4
	Using equipment improperly		1				1		2
	Failure to warn	1							1
	Failure to secure				1				1
	Failure to follow procedures						1		1
Substandard Conditions	Hazardous environmental conditions						1		1
	Inadequate sign or label					1			1
Total Injuries									**13**
Basic Causes									
Job Factors	Inadequate leadership/supervision	1	2						3
	Inadequate tools and equipment				1				1
	Inadequate work standards				1	1			2
	Inadequate engineering						1		1
Personal Factors	Poor Judgment		1				1	1	3
	Lack of knowledge						1		1
	Improper motivation	1				1			2
Total Injuries									**13**

* Note that the total number of injuries in this table is lower than that shown in Table 2.2. This is due to an incident wherein a vehicle being driven by a contract employee was struck by a stolen vehicle entering the highway from a ditch.

TABLE 2.3

Non-Compliances Observed on NEB Construction Safety Inspections

Type of Non-Compliance	2005	2006
Personal Protective Equipment		
Hearing Protection	1	1
Face Shields or Safety Glasses	14	5
Hard Hats	1	2
High Visibility Vests	0	1
Unsafe Work Practices		
Riding Suspended Pipe/Straddling Pipe	3	4
Pinch Points	3	3
Guidelines/Tag Lines	0	1
Explosion Hazard	0	0
Ingress/Egress	1	0
MSDS	0	1
Danger Zones	1	1
Scaffolding	0	0
Total Number of Non-compliances Observed	**24**	**19**
Number of NEB Construction Safety Inspections Conducted	**14**	**14**

They are recorded and tracked, and special attention is paid by the NEB and companies to those non-compliances which are commonly observed. In this way, both the NEB and its regulated companies are able to employ a proactive approach to incident prevention and help encourage the development of a safety culture at all construction sites.

The NEB continues to inspect pipeline construction to monitor and evaluate field activities and to better understand and communicate to the industry the measures that can be taken to improve worker safety.

2.3 Ruptures

Ruptures are defined in Annex H of CSA Z662[3] as a "loss of containment event that immediately impairs the operation of the pipeline". Pipeline ruptures have the potential to be severely detrimental to safety and the environment.

Ruptures are always investigated and analyzed to determine their primary cause. This report considers the number of ruptures and their primary cause from 1991 onward for all NEB-regulated pipelines. The year 2006 is the fourth consecutive year in which there have been no reported ruptures on NEB-regulated pipelines.

As shown in Figure 2.8 between 1991 and 2002, there was an average of 2.5 ruptures per year and zero ruptures thereafter. Beginning in 1999, companies were required under the OPR-99 to have integrity management programs. The proactive nature and the evolution of individual company integrity management programs may be responsible for the low number of ruptures since 2002.

3 The definition of "rupture" is the same in both the 2003 and 2007 editions of CSA Z662.

FIGURE 2.8

NEB-Regulated Pipeline Ruptures

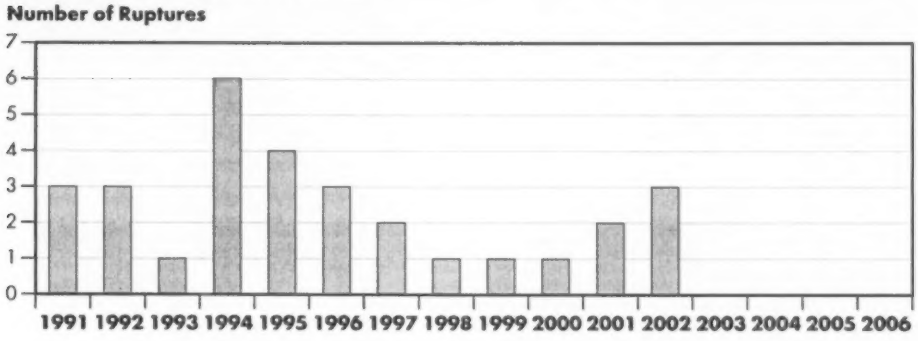


Table 2.4 provides a breakdown of reported ruptures on NEB-regulated pipelines and their primary cause while Figure 2.9 shows the data in graphical form. The primary cause of ruptures on NEB-regulated pipelines between 1991 and 2006 was cracking, followed by metal loss. Cracking includes hydrogen-induced and mechanical damage delayed cracking, stress corrosion, and corrosion fatigue. Metal loss includes both internal and external corrosion. The category of "Other Causes" includes improper operation, fire and yet to be determined causes.

TABLE 2.4

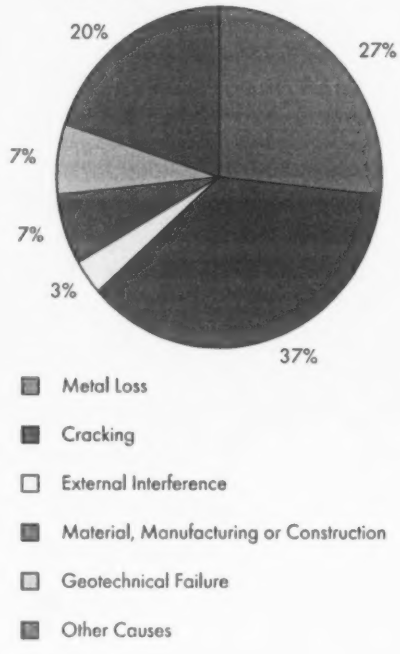
Rupture Primary Causes

Year	Number of Ruptures	Primary Causes					
		Metal Loss	Cracking	External Interference	Material, Manufacturing or Construction	Geotechnical Failure	Other Causes
1991	3		2		1		
1992	3	1	1				1
1993	1			1			
1994	6	2	1			1	2
1995	4	1	3				
1996	3	2	1				
1997	2	1				1	
1998	1						1
1999	1		1				
2000	1				1		
2001	2	1	1				
2002	3		1				2
2003	0						
2004	0						
2005	0						
2006	0						
Total	**30**	**8**	**11**	**1**	**2**	**2**	**6**

Some pipelines of specific vintage and of certain construction methods have experienced higher rupture frequencies than others.[4] Since 1991, no ruptures have occurred on NEB-regulated pipelines that have been in operation for less than 12 years. A number of factors have contributed to the absence of ruptures on new pipelines, including the quality of pipeline coatings and cathodic protection, new construction methods, effective pressure testing and well-developed integrity management programs.

FIGURE 2.9

NEB Pipeline Ruptures – Primary Causes



Rupture Cause Comparisons

Figure 2.10 compares the distribution of NEB-regulated pipeline ruptures since 1991 by cause to those reported by the ERCB, PHMSA and EGIG. While each organization has different timeframes over which they have examined rupture causes, evidence from these organizations suggests that the leading cause of ruptures generally remains constant over time.

To facilitate a more representative comparison between organizations with different reporting criteria, ruptures caused by metal loss and cracking, as defined by CSA Z662, have been combined and compared to ruptures caused by corrosion. Ruptures brought on by natural causes are compared with geotechnical and other causes.

Again, note that the leading cause of ruptures on NEB-regulated pipelines is corrosion, including cracking and metal loss. In contrast, U.S. data from PHMSA indicate that while corrosion is still a leading cause, external interference constitutes the second most frequent cause of pipeline ruptures. EGIG and ERCB data indicate that external interference is the leading cause of pipeline ruptures.

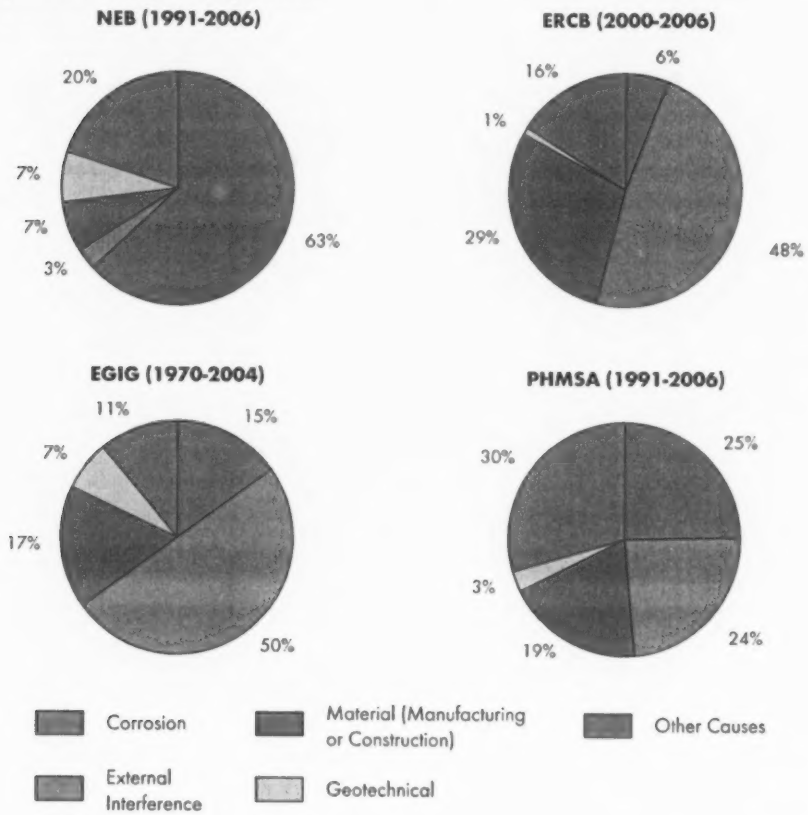
Because of differences in pipeline content and purpose (i.e., gathering, transmission, distribution), exact comparisons are difficult. This may account for differences in rupture or failure modes. The population densities in the U.S. and Europe are significantly greater than that of Canada, which may account for the increased number of ruptures caused by external interference reported to PHMSA and EGIG. The density of the ERCB-regulated pipeline network coupled with high levels of construction in the Alberta oil and gas sector may account for higher external interference rates in Alberta.

Photo by Marc Pauzé

4 Jeglic, F. Analysis of Ruptures and Trends on major Canadian Pipeline Systems. National Energy Board, Calgary, Canada, 2004.

FIGURE 2.10

Comparison of Rupture by Cause



2.4 Pipeline Unauthorized Activities

Unauthorized activities reported under the NEB *Pipeline Crossing Regulations (Part I and Part II)* include actions that have the potential to damage a pipeline or that may impede access to a pipeline for the purposes of maintenance or emergency response.

Unauthorized activities or events considered to be indicators related to pipeline integrity include:

- movement of vehicles or equipment over pipelines;
- construction activities with no soil disturbance;
- construction, landscaping, or grading that results in soil disturbance; and
- construction, landscaping, or grading that results in pipeline contact.

The number of reported, unauthorized activities with the potential to damage pipelines is provided in Table 2.5.

The total number of unauthorized activities decreased from 71 in 2005 to 66 in 2006, however in both years the numbers of unauthorized activities are above the seven-year average of 51.3. The number of pipeline contacts is consistently low, ranging from 1 to 2 per year, or less than 5 percent of the

TABLE 2.5

Unauthorized Activities on Rights of Way

Year	Activities With No Soil Disturbance		Actvities With Soil Disturbance		Pipeline Contacts		Total
	Landowner	Contractor	Landowner	Contractor	Landowner	Contractor	
2000	5	0	12	26	0	2	45
2001	7	0	14	27	1	0	49
2002	2	0	7	13	0	1	23
2003	9	4	7	30	2	0	52
2004	4	2	12	33	1	1	53
2005	11	2	20	37	0	1	71
2006	6	4	23	32	0	1	66
Average	6.3	1.7	13.6	28.3	0.6	0.9	51.3

total number of unauthorized activities. Increasing urban encroachment on pipeline rights of way is expected to become a more significant concern in the future and may result in an increased number of unauthorized activities along rights of way.

2.5 Liquid Releases, Leaks and Spills

NEB-Regulated Liquid Pipelines

Pipe Body Liquid Releases (Ruptures and Leaks)

For the purpose of this report, any pipe body failure (including ruptures and leaks) resulting in a volume greater than 1.5 m^3 is considered a liquid release. Liquid releases of volumes less than 1.5 m^3 are not considered reportable incidents under OPR-99 (although data regarding liquid releases of volumes less than 1.5 m^3 were requested under the voluntary reporting initiative).

Table 2.6 shows the number and total volume of liquid releases from the pipe body on NEB-regulated liquid pipelines between 2000 and 2006.

NEB-regulated pipelines experienced few pipe body liquid releases over the period of 2000 to 2006. There were no liquid releases in 2000, 2003 or 2004 from NEB-regulated pipelines and although there were four liquid pipe body releases in 2006 they were all of relatively small volumes. Overall, NEB-regulated liquid pipelines have a seven year average of 0.09 pipe body liquid releases per 1 000 kilometres or 1 pipe body liquid release per 11 100 kilometres of liquid pipelines.

TABLE 2.6

Pipe Body Liquid Releases

Year	Number of Releases >1.5 m^3	Total Release Volume (m^3)
2000	0	0
2001	2	3 650
2002	2	52
2003	0	0
2004	0	0
2005	2	254
2006	4	39

Pipe Body Liquid Release Frequency Comparisons

Figure 2.11 compares the pipe body liquid release frequency for NEB-regulated liquid pipelines to that of reference organizations. It is important

when considering this comparison to bear in mind that reporting criteria for liquid releases may vary slightly from organization to organization and as such a perfect comparison is not possible. Reporting requirements for each reference organization are provided in Table A2.3 in Appendix A2. However, in an effort to make the comparison as meaningful as possible, data from PHMSA, CONCAWE and the ERCB have been sorted in order to ensure that only those incidents which meet NEB reporting criteria are represented in Figure 2.11.

The NEB has shown fewer pipe body liquid releases than reference organizations almost every year since 2000. This may be due, in part, to the higher frequency of pipeline contacts by third parties experienced by PHMSA.

Pipe Body Liquid Release Volume Comparisons

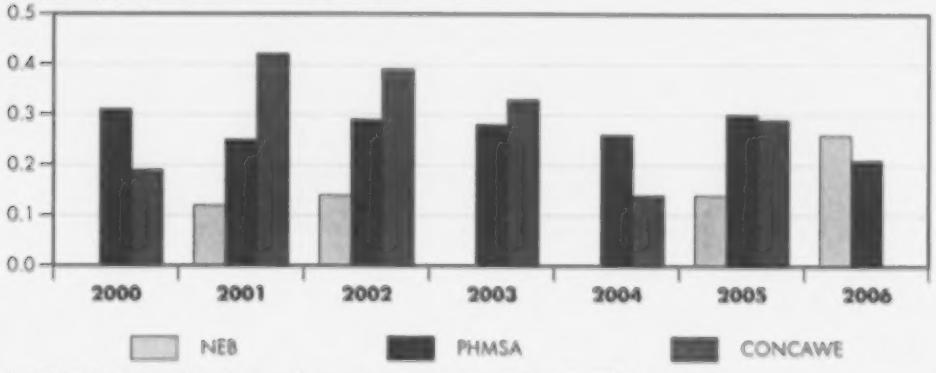
Figure 2.12 shows the liquid release volume over the pipeline length for NEB-regulated pipelines and reference organizations from 2000 to 2006.

The data presented in Figure 2.12 indicate that a single large rupture or break can have a significant impact on the liquid release volume frequency indicator. This is particularly evident for the NEB in

FIGURE 2.11

Pipe Body Liquid Release Frequency Comparisons*

Frequency (Number of Releases per 1 000 km)

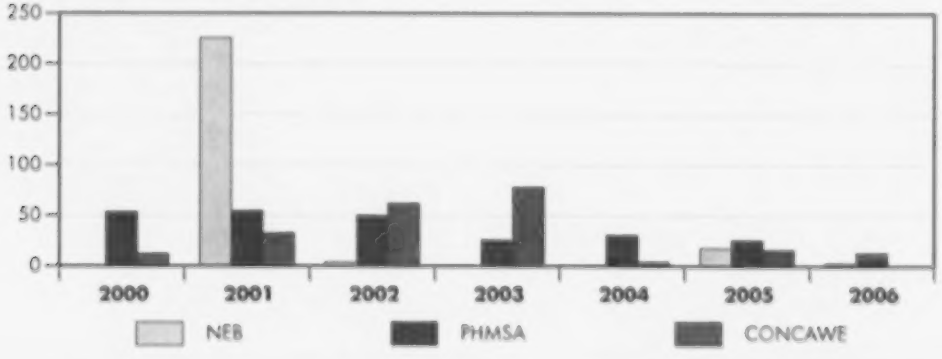


* CONCAWE pipe body liquid release frequency data are not yet available for 2006.

FIGURE 2.12

Pipe Body Liquid Release Volume Frequency Comparisons

m^3 of liquid released per 1 000 km



2001 where a large event set this indicator's upper range in excess of 200 m^3 per 1 000 kilometres of liquid pipelines.

Operational Liquid Leaks (Releases from non-pipe body sources)

Operational leaks on liquid pipelines are product leaks associated with pipeline operations and originate from pipeline components such as flanges, valves, pumps and storage tanks. These leaks are usually contained within fenced pipeline facilities and exclude leaks from pipe bodies. Typically, these kinds of leaks are less than 1.5 m^3; however, they can be very large.

Table 2.7 shows the number and volume of operational liquid leaks for NEB-regulated liquid pipelines for the seven-year period from 2000 through 2006.

A large liquid leak in 2002 occurred at a pump station (1 075 m^3), and a large leak (950 m^3) in 2005 occurred at an oil terminal, which resulted in a high total leak volume for those years.

On average, approximately 44 leaks per year are reported on NEB-regulated pipeline systems. Much like pipe body releases, a single large leak from other pipeline components can have a significant impact on total annual leak volume.

TABLE 2.7

Operational Liquid Leaks

Year	Number of Leaks (≤1.5 m^3)	Number of Leaks (>1.5 m^3)	Total Number of Leaks	Total Leak Volume (m^3)
2000	42	2	44	102
2001	15	4	19	279
2002	38	9	47	1 184
2003	43	1	44	13
2004	57	5	62	34
2005	48	3	51	1 269
2006	25	7	32	322

* Table 2.6, Figure 2.13, and Table 2.7 all data updated from last year based on further review.

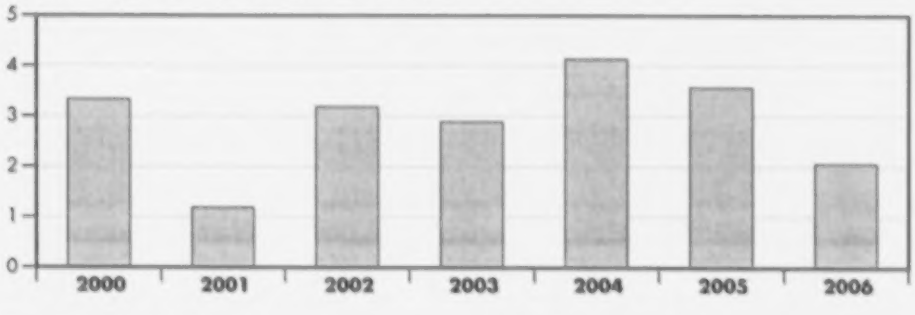
No reference organizations publish a liquid leak frequency comparable to that of the NEB. Figure 2.13 shows the liquid leak frequency indicator for NEB-regulated liquid pipelines from 2000 through 2006.

The frequency of liquid leaks from non-pipe body sources has shown a seven year average of approximately 3 leaks per 1 000 km of pipeline. In 2006 the frequency reached a five year low at 2.5 down from 3.6 in 2005.

FIGURE 2.13

NEB-Regulated Pipelines Operational Liquid Leak Frequency

Frequency (Number of leaks per 1 000 km)



Non-pipeline Liquid Spills

Liquid spills are spills associated with pipeline construction, maintenance and operations on both liquid and gas pipelines. They include small volumes of hydraulic, lubrication, valve operator fluids or equipment fuels, but exclude product leaks from liquid pipeline systems. Table 2.8 shows the volume and combined number of liquid spills both greater than and less than 1.5 m^3.

TABLE 2.8

Non-product Liquid Spills on NEB-Regulated Liquid and Gas Pipelines

Year	Number of Spills (≤1.5 m^3)	Number of Spills (>1.5 m^3)	Total Number of Spills	Total Spill Volume (m^3)
2000	227	0	227	16
2001	28	1	29	3
2002	25	0	25	2
2003	48	1	49	5
2004	64	1	65	4
2005	47	1	48	12
2006	125	0	125	3

High levels of construction activity in 2000 caused a significant number of reported spills. Overall, the average volume per spill is small, with the seven-year average being 2.4 m^3 per spill.

2.6 Gas Releases and Leaks

NEB-Regulated Gas Pipelines

Pipe Body Gas Releases and Operational Leaks

For the purpose of this report, pipe body gas releases and operational leaks are defined as follows:

- Pipe body gas releases are the result of pipe body failures and include both ruptures and leaks.
- Operational gas leaks can occur through equipment including venting from valves and through seepage at flanges through gaskets.

TABLE 2.9

Gas Releases and Leaks on NEB-Regulated Pipelines

Year	Pipe Body Gas Releases	Operational Pipeline Gas Leaks
2000	1	24
2001	1	23
2002	2	11
2003	0	11
2004	4	19
2005	4	18
2006	1	22

The data presented here do not include the release of gas from planned events, such as venting or blowdowns. All unintended or uncontrolled gas leaks on NEB-regulated pipelines must be reported and there is no minimum reportable volume associated with gas releases or leaks.

The data used to calculate the gas release and leak frequencies for NEB-regulated pipelines are shown in Table 2.9.

Pipe Body Gas Release Frequency Comparisons

Figure 2.14 shows the pipe body gas release frequency for NEB-regulated gas pipelines and PHMSA-regulated gas pipelines. The reporting criteria for

gas releases vary between the reference organizations. These differences are summarized in Table A2.4 in Appendix A2. In an effort to produce a more meaningful comparison, the PHMSA data were analyzed so that hydrocarbon releases not clearly indicated as originating from the pipe body were removed from the aggregate data.

The seven-year average of the gas pipe body release frequency for NEB-regulated pipelines is approximately 0.07 releases per 1 000 kilometres or one gas release per 14 300 kilometres.

The NEB gas release frequencies are generally lower than the PHMSA frequencies and while the NEB gas release frequency was elevated in 2004 and 2005, in 2006 the frequency decreased to levels comparable to 2000 and 2001 levels.

Operational Gas Leak Frequency

Figure 2.15 shows the gas leak frequency for NEB-regulated gas pipelines from non-pipe body sources.

At a frequency of approximately 0.75 leaks per 1 000 kilometres, operational gas leaks on NEB-regulated gas pipelines occur about 10 times more often than pipe body gas releases as shown in Figure 2.15.

FIGURE 2.14

Pipe Body Gas Release Frequency Comparisons

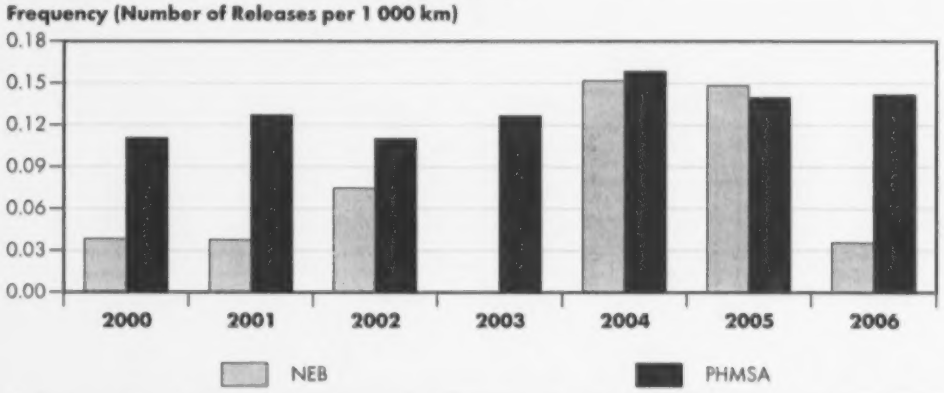
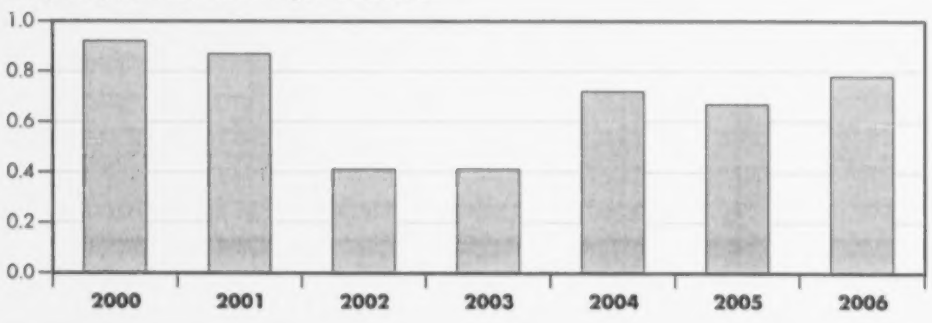


FIGURE 2.15

NEB-Regulated Pipelines Operation Gas Leak Frequency



Due to the differences in reporting requirements for gas leaks between the NEB and PHMSA, comparisons between operational gas leak frequencies are not possible. The NEB requires that all gas leaks be reported, whereas PHMSA requires only those resulting in a fatality, hospitalization, or a property loss of more than US$50 000 be reported.

2.7 NEB Reportable Incidents

NEB-regulated companies are legally required to report to the NEB incidents as per section 52.(1) of the OPR-99, which states:

> *"A company shall immediately notify the Board of any incident relating to the construction, operation or abandonment of its pipeline and shall submit a preliminary and detailed incident report to the Board as soon as is practicable."*

The data presented here do not include voluntarily reported incidents. Under OPR-99, NEB-regulated companies must report the following:

- death or serious personal injury;
- a significant adverse effect on the environment;
- an unintended fire or explosion;
- the unintended or uncontained release of LVP hydrocarbon liquids in excess of 1.5 m^3;
- the unintended or uncontrolled releases of gas or HVP hydrocarbons; and
- the operation of a pipeline beyond its design limits as determined under CSA Z662, CSA Z276 or any operating limits imposed by the Board.

Figure 2.16 shows all pipeline incidents meeting NEB regulatory reporting requirements by type. A total of 263 incidents were reported from 2000 to 2006 with a seven year average of 38 incidents per year. Gas releases are the most common incident reported each year. This may be a result of the fact that under the OPR-99, all gas releases regardless of volume, whereas only liquid releases larger than 1.5 m^3, are reportable.

FIGURE 2.16

OPR Incidents by Occurrence Type

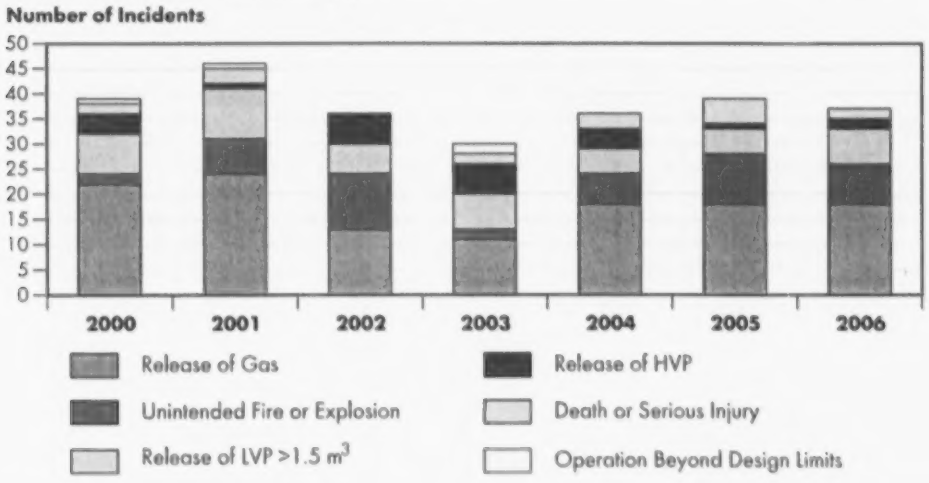
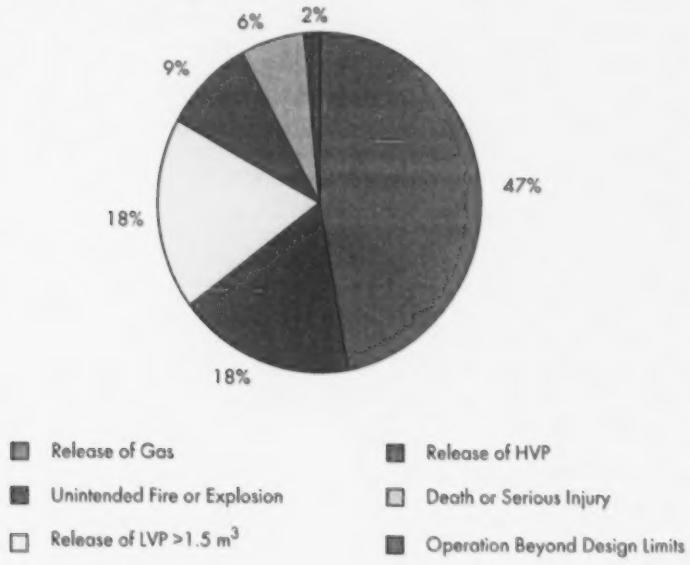


Figure 2.17 shows the average percentage of all reportable pipeline incidents by type from 2000 to 2006. On average, unintended or uncontrolled gas releases account for almost half of all incidents. Again, this may be due to the fact that all gas releases, regardless of volume, are reportable. The next most common incidents are unintended or uncontained releases of LVP hydrocarbon liquids in excess of 1.5m^3 and unintended fires or explosions.

FIGURE 2.17

OPR Incidents by Incident Type



CONCLUSION

The National Energy Board continuously searches for ways to improve its performance. The sixth annual Focus on Safety and Environment – A Comparative Analysis of Pipeline Performance is one of our safety report cards. Examining the safety, integrity and environmental performance of NEB-regulated pipelines and comparing the results to their past performance and to that of pipelines regulated by similar organizations is just one of the ways the NEB meets its objective to track and regularly report on results and best practices.

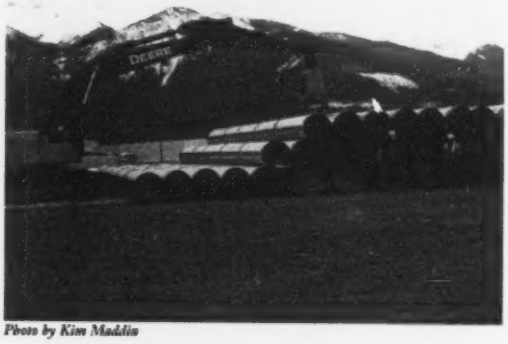


Photo by Kim Maddin

In 2006, NEB-regulated pipelines shipped more than $110 billion worth of crude oil, natural gas and petroleum products across the country and on to export markets. In fact, energy accounted for 22 per cent of all Canadian goods or services exported in 2006 . The NEB regulates nearly 45,000 km of pipelines and in 2006, only 37 incidents related to pipeline safety, integrity and the environment were reported.

Throughout 2006, many people were employed on the construction, maintenance and operation of NEB-regulated pipelines. Work hours for more than 3,000 full-time equivalent workers were provided to the NEB and considered in this publication. For the ninth year in a row, there were no fatalities on NEB-regulated pipelines.

2006 marked the fourth consecutive year there were no ruptures on NEB-regulated pipelines. Between 1991 and 2002, there was an average of 2.5 ruptures every year. This improvement appears to be directly related to the proactive nature and sophistication of integrity management programs incorporated by pipeline companies after the Board introduced OPR-99 in June 1999.

Although the number of liquid releases greater than 1 500 litres increased slightly in 2006, the total volume of petroleum products involved was very low: approximately 14 times lower than the 2000-2006 average. Reducing ruptures, releases, leaks and spills is an important element in protecting the environment.

While the NEB is proud of this safety and environmental record, it also recognizes that there is room for improvement. In 2006, the number of injuries per year to employees working on pipelines more than doubled from 2005 to 1.5 injuries for every 100 full-time employees. For the first time in seven years, the annual injury frequency for company employees was nearly identical to the annual injury frequency for contractors, which rose to 1.6 injuries for every 100 full-time equivalent contract workers in 2006. Just one year earlier, pipeline contractors were injured approximately 1.9 times more often than a pipeline company's employees.

The Board is understandably concerned with this new trend. Although there are no clear answers to explain the apparent increase in the frequency of workplace injuries, there are a number of contributing factors which may include:

- High turnover rates in the red-hot pipeline industry;
- Lack of or inadequate training;
- Fatigue due to tight construction schedules;
- Fatigue due to resource issues;
- Age of worker; and,
- Level of experience.

The Board will continue to monitor this trend and work with its partners in industry to improve workplace safety.

As the pipeline industry prepares for another busy construction season, the safety performance indicators in this report point to a need for increased vigilance in ensuring that the well developed and documented safety programs within industry are translated into reduced injury frequencies and a safer workplace. The Board will use the performance metrics within this report in developing and prioritizing its future compliance verification plans. Some of the activities undertaken by the NEB to promote safety and environmental protection include:

- Partnerships with other regulators to enhance stakeholder understanding and awareness of safety and environmental aspects of the pipeline industry;
- Active participation with industry in areas such as standards development and pipeline research;
- Leadership roles in the development of content for not-for-profit conferences such as the International Pipeline Conference and the Banff Pipeline Workshop;
- International collaboration on compliance and regulation such as with the US Pipeline and Hazardous Materials Safety Administration;
- Audits, investigations and inspections; and,
- Participation in initiatives such as the Canadian Common Ground Alliance designed to increase awareness and promote best practices for excavation and construction near pipelines.

Photo by Marc Pauzé

The Board is committed to a risk-based life cycle approach which enables the NEB to focus its resources where they count the most.

Contractor	individual employed by a company which in turn is employed by an NEB-regulated company.
Contractor Fatalities	fatalities which occur while a contract worker is involved in activities pursuant to his/her contract with a pipeline company.
Disabling Injury Frequency	the number of fatalities plus lost time injuries plus restricted workday injuries multiplied by 200 000 and divided by the corresponding employee, contractor or combined employee and contractor (worker) hours worked.
Employee	individual employed directly by the NEB-regulated company.
Employee Fatalities	fatalities which occur while an employee is involved in activities associated with their job duties.
Injury Frequency	the number of lost time and restricted workday injuries multiplied by 200 000 and divided by the corresponding employee, contractor or worker hours worked.
Lost Time Injury	any occupational injury that prevents an employee from reporting for work or from effectively performing all the duties connected with the employee's regular work on any day subsequent to the day on which the injury occurred, whether or not that subsequent day is a working day for the employee (definition of "disabling injury" in *Canada Occupational Health and Safety Regulations Part XV*, section 15.1(a))
Non-Pipeline Liquid Spills	spills are associated with small volumes of lubrication and hydraulic oils and fuel spilled during pipeline construction, maintenance and gas pipeline operations.
Non-Pipeline Liquid Spills Frequency	the number of liquid spills from integral gas pipeline components and the number of liquid spills caused by pipeline construction and maintenance activities multiplied by 1 000 and divided by the combined total kilometres of liquid and gas pipelines.
Operational Gas Leak Frequency	the total number of gas leaks caused by components integral to the operation of gas pipelines multiplied by 1 000 and divided by the total kilometres of gas pipelines.
Operational Liquid Leak Frequency	the number of liquid leaks caused by components integral to the operation of liquid pipelines multiplied by 1 000 and divided by the total kilometres of liquid pipelines.

Operational Liquid Leaks	associated with the operation of pipeline systems and arise from other components such as flanges, valves, compressors and pumps. Typically, liquid leaks are less than 1.5 m^3 but, they can be larger.
Performance Indicator	a statistic or parameter that, tracked over time, provides information on trends in the condition of a phenomenon.
Pipe Body Gas Release Frequency	the number of releases caused by gas pipeline body failure multiplied by 1 000 and divided by the total kilometres of gas pipelines.
Pipe Body Liquid Releases	pipe body failures that exceed 1.5 m^3 of liquids
Pipe Body Liquid Release Frequency	the number of releases exceeding 1.5 m^3 caused by liquid pipeline body failure multiplied by 1 000 and divided by the total kilometres of liquid pipelines.
Pipe Body Liquid Release Volume Frequency	the volume released from a liquid pipeline body failure multiplied by 1 000 and divided by the total kilometres of liquid pipelines.
Reportable Incidents (under the OPR-99):	• Death or serious personal injury; • A significant adverse effect on the environment; • An unintended fire or explosion; • The unintended or uncontained release of low vapour pressure hydrocarbon liquids (LVP) in excess of 1.5 m^3; • The unintended or uncontrolled releases of gas or high vapour pressure hydrocarbons (HVP); and • The operation of a pipeline beyond its design limits as determined under CSA Z662, CSA Z276 or any operating limits imposed by the Board.
Ruptures	loss of containment event that immediately impairs the operation of the pipeline (Annex H to CSA Z662-03)
Serious Injury (under the OPR-99)	includes an injury that results in (a) the fracture of a major bone; (b) the amputation of a body part; (c) the loss of sight in one or both eyes; (d) internal hemorrhage; (e) third degree burns; (f) unconsciousness; or (g) the loss of a body part or function of a body part.
Third Party Fatalities	these are fatalities involving persons other than contractors or employees.
Worker	refers to the combined data for employees and contractors

A1 Reference Organizations and Data Sources

Organizations chosen for comparative analysis of data within this report have been selected based on their similarities to the NEB. A comparison of the terms used within each reference organization is provided in Appendix A2.

A1.1 Human Resources and Skills Development Canada (HRSDC)

Website: www.hrsdc.gc.ca

Under the Canadian constitution, labour legislation is primarily a provincial responsibility. The federal government, however, administers labour affairs in specific sectors including certain works and industries such as pipelines which have inter-provincial or international character.

The Labour Program of Human Resources and Skills Development Canada (HRSDC) is responsible for developing, administering and enforcing legislation and regulations related to the workplace, including the Canada Labour Code Part II – Occupational Health and Safety (CLC Part II).

HRSDC collects, researches and analyses data pertaining to health and safety at all federally regulated workplaces, including those regulated by the NEB.

HRSDC data is presented within this report for comparative purposes for the following performance indicator:

- Injury Frequency.

Data Sources

Occupational Injuries Among Canadian Federal Jurisdiction Employers, 1998-2002.
Occupational Injuries Among Canadian Federal Jurisdiction Employers, 2001-2005.

A1.2 Energy Resources Conservation Board (ERCB)

Website: www.ercb.ca

The Energy Resources Conservation Board (ERCB) is an independent, quasi-judicial agency of the Government of Alberta. Its mission is to ensure that the discovery, development, and delivery of Alberta's resources takes place in a manner that is fair, responsible, and in the public interest.

The ERCB regulates the safe, responsible, and efficient development of Alberta's energy resources including oil, natural gas, oil sands, coal, and electrical energy.

Regulation is done through four core functions: adjudication and regulation, applications, surveillance and enforcement, and information and knowledge.

ERCB data is presented within this report for comparative purposes for the following performance indicators:

- Ruptures.

Data Sources

Written correspondence:

Dated 4 April 2003, 20 hydrocarbon liquid releases from crude oil pipelines in 2000 and 24 releases in 2001 and corresponding crude oil release volumes;

Dated 17 December 2003, 13 hydrocarbon liquid releases from crude oil pipelines in 2002 and corresponding crude oil release volumes;

Dated 17 December 2004, 13 hydrocarbon liquid releases from crude oil pipelines in 2003 and corresponding crude oil release volumes;

Dated 31 October 2005, 22 hydrocarbon liquid releases from crude oil pipelines in 2004 and corresponding crude oil release volumes.

Dated 15 January 2007, 24 hydrocarbon liquid releases from crude oil pipelines in 2004 and corresponding crude oil release volumes.

Statistical Series 57 - Field Surveillance Provincial Summary:

April 2001/March 2002, published in July 2002;

January–December 2002, published in May 2003.

January–December 2003, published in April 2004.

January–December 2004, published in May 2005.

Statistical Series 99 - EUB Provincial Surveillance and Compliance Summary:

January-December 2005, published in June 2006

Photo by Marc Pauzé

A1.3 Canadian Association of Petroleum Producers (CAPP)

Website: www.capp.ca

The Canadian Association of Petroleum Producers (CAPP) represents more than 150 member companies and 130 associate members who explore for, develop and produce natural gas, natural gas liquids, crude oil, oil sands, and elemental sulphur throughout Canada. CAPP member companies produce more than 95 per cent of Canada's natural gas and crude oil. CAPP also has 125 associate members that provide a wide range of services that support the upstream crude oil and natural gas industry. Together, these members and associate members are an important part of a $100-billion-a-year national industry that affects the livelihoods of more than half a million Canadians.

CAPP data is presented within this report for comparative purposes for the following performance indicators:

- Injury Frequency.

Data Sources

2006 Stewardship Progress Report, published by the Canadian Association of Petroleum Producers in January 2007.

A1.4 Pipe Line Contractors Association of Canada (PLCAC)

Website: www.pipeline.ca

The Pipe Line Contractors Association of Canada (PLCAC) represents contractors in labour relations matters and establishes training courses for the development of Canadian workers in special pipeline construction skills.

PLCAC interests and activities extend to issues such as occupational health and safety, legislative review, pipeline standards and codes and a host of other activities.

PLCAC data is presented within this report for comparative purposes for the following performance indicator:

- Injury Frequency.

Data Sources

Mainline Contractor Injury Frequencies, Safety Statistics Page from http://www.pipeline.ca/.

A1.5 United States Department of Transport, Pipeline and Hazardous Material Safety Administration - Office of Pipeline Safety (PHMSA)

Website: http://phmsa.dot.gov

The Pipeline and Hazardous Material Safety Administration (PHMSA) administers the Department of Transport's national regulatory program to assure the safe transportation of natural gas, petroleum, and other hazardous materials by pipeline. The PHMSA develops regulations and other approaches to risk management to assure safety in design, construction, testing, operation, maintenance, and emergency response of pipeline facilities.

PHMSA safety jurisdiction over pipelines covers more than 3 000 gathering, transmission, and distribution operators as well as some 52 000 master meter and liquefied natural gas operators who own and/or operate approximately 1.6 million miles of gas pipelines, in addition to over 200 operators and an estimated 155 000 miles of hazardous liquid pipelines.

For the purposes of this report, only information on gas transmission and hazardous liquid pipelines has been used. PHMSA data is presented within this report for comparative purposes for the following performance indicators:

- Ruptures;

- Liquid Releases; and
- Gas Releases.

Data Sources

PHMSA website:

- Natural Gas Transmission Incident Data – mid-1984 to 2001 and 2002 to present;
- Hazardous Liquid Accident Data – 2000 to 2006 Statistics

Photo by Laura Randall

A1.6 United States Department of Labor - Bureau of Labor Statistics (BLS)

Website: www.bls.gov

The Bureau of Labor Statistics (BLS) is the principal fact-finding agency for the Federal Government of the United States in the broad field of labor economics and statistics. The BLS is an independent national statistical agency that collects, processes, analyzes, and disseminates essential statistical data to the American public, the U.S. Congress, other Federal agencies, State and local governments, business, and labor. The BLS also serves as a statistical resource to the Department of Labor.

BLS data must satisfy a number of criteria, including relevance to current social and economic issues, timeliness in reflecting today's rapidly changing economic conditions, accuracy and consistently high statistical quality, and impartiality in both subject matter and presentation.

BLS began using the 2002 North American Industry Classification System (NAICS) to compile the 2003 Workplace Injuries and Illnesses data. As a result, the classifications used in this report changed slightly from last year and better represents the work activities that occur in relation to pipelines. As such, caution should be taken when comparing to previous years.

BLS data is presented within this report for comparative purposes for the following performance indicator:

- Injury Frequency.

Data Sources

U.S. Department of Labor website:

- Table 1, Incidence rates of non-fatal occupational injuries and illnesses by industry and selected case types, 2000 through 2002 inclusive. Contractor is "Heavy construction, except highway", and employee is "Gas production and distribution";
- Table 1, Incidence rates of non-fatal occupational injuries and illnesses by industry and selected case types, 2003 and 2004. Contractor is "2371 Utility System Construction"; and employee is "486 Pipeline Transportation".
- Table 1, Incidence rates of nonfatal occupational injuries and illnesses by selected industries and case types, 2005. Contractor is "2371 Utility System Construction"; and employee is "486 Pipeline Transportation".

- Table 1, Incidence rates of nonfatal occupational injuries and illnesses by selected industries and case types, 2006. Contractor is "2371 Utility System Construction"; and employee is "486 Pipeline Transportation".

Lost workday injuries where total lost workday cases involve days away from work, days of restricted work activity or both.

A1.7 European Gas Pipeline Incident Data Group (EGIG)

Website: www.egig.nl

In 1982 six European gas transmission system operators took the initiative to gather data on the unintentional releases of gas in their pipeline transmission systems. This co-operation was formalized by the setting up of EGIG (European Gas pipeline Incident data Group). Now EGIG is a co-operation between a group of nine major gas transmission system operators in Western Europe and is the owner of an extensive gas pipeline-incident database.

The creation of this extensive pipeline-incident database (1982) has helped pipeline operators to demonstrate the safety performances of Europe's gas pipelines. This information has helped the pipeline operators to improve safety in their gas pipeline transmission systems.

Considering the number of participants, the extent of the pipeline systems and the exposure period involved (from 1970 onwards for most of the companies), the EGIG database is a valuable and reliable source of information. The regional differences are not taken into account so that the result of the database presents an average of all participating companies.

EGIG data is presented within this report for comparative purposes for the following performance indicators:

- Ruptures.

Data Sources

3rd EGIG Report, 1970-1997 Gas Pipeline Incidents, Document No. EGIG 98.R.0120 published in December 1998.

5th EGIG Report, 1970-2001 Gas Pipeline Incidents, Document No. EGIG 02.R.0058, published in December 2002.

6th EGIG Report, 1970-2004 Gas Pipeline Incidents, Document No. EGIG 05.R.0002, published in December 2005.

Data published at www.egig.nl (the EGIG website). Mileage interpolated from the incident frequency rate.

A1.8 European Oil Companies Association for Environment, Health and Safety (CONCAWE)

Website: www.concawe.be

Most oil companies who refine crude oil in Western (OECD) Europe are members of CONCAWE. CONCAWE is founded as an international association with a scientific objective and without profit-making intent. The organization produces sound economic, technical and scientific information.

CONCAWE data is presented within this report for comparative purposes for the following performance indicator:

- Liquid Releases.

Data Sources

Western European Cross Country Oil Pipelines 30 Year Performance Statistics, Report No. 1/02 published in February 2002, page 48.

Performance of European cross-country oil pipelines – statistical summary of reported spillages – 2001, report no. 1/03, published February 2003.

Performance of European cross-country oil pipelines – statistical summary of reported spillages – 2002, report no. 7/04.

Performance of European cross-country oil pipelines - statistical summary of reported spillages – 2003, Report no. 3/05, published May 2005.

Performance of European cross-country oil pipelines – statistical summary of reported spillages – 2004, Report no. 3/06, published June 2006.

Performance of European cross-country oil pipelines – statistical summary of reported spillages – 2005, Report no. 4/07, published May 2007.

A1.9 International Association of Oil and Gas Producers (OGP)

Website: www.ogp.org.uk

The International Association of Oil and Gas Producers (OGP) is a worldwide association of oil and gas companies involved in exploration and production. OGP members include private and state-owned oil and gas companies, national associations and petroleum institutes. OGP's purpose is to:

- provide information to interested bodies on the oil and gas exploration and production industry;
- represent member's interests at global and regional regulatory bodies; and
- develop operating guidelines.

OGP data is presented within this report for comparative purposes for the following performance indicator:

- Injury Frequency.

Data Sources

Safety Performance of the Global E & P Industry, 2000 by the International Association of Oil and Gas Producers, Report No. 6.93/319, published June 2001.

Safety Performance of the Global E & P Industry, 2001 by the International Association of Oil and Gas Producers, Report No. 6.59/330, published July 2002.

Safety Performance of the Global E & P Industry, 2002 by the International association of Oil and Gas Producers, Report No. 345, published June 2003.

Safety Performance Indicators 2003, Report No. 353, published in June 2004.

Safety Performance Indicators, 2004, Report No. 367, published in May 2005.

Safety Performance Indicators, 2005, Report No. 379, published in May 2006.

Safety Performance Indicators, 2006, Report No. 391, published in June 2007.

A2 Reporting Criteria and Injury Definitions

TABLE A2.1

Comparison of Reporting Criteria for Ruptures

Source	Reporting Requirements
NEB	Rupture "Loss of containment event that immediately impairs the operation of the pipeline." (per CSA Z662-3, Annex H)
ERCB	When a leak or break occurs in a pipeline, the licensee shall immediately cause the Board to be informed of the location of the leak or break. "Break" means a rupture in any part of a pipeline and "leak" means the escape of substance from a pipeline.
PHMSA	Incident: Gas releases that were associated with a death or personal injury requiring hospitalization, or a total cost of US$50,000 or more. Loss of 8 or more cubic metres of hazardous liquids or where property damage costs exceed US$50,000. After 7 February 2002, a release of 5 gallons (19 litres) or more.
EGIG	Incidents include any unintentional release of gas which occurs on an onshore pipeline operating at greater than 1500 kPa outside of the fenced boundaries of installations and excluding all components except the pipe.

Table A2.2 provides a summary of the 'injury' definitions used by reference organizations.

TABLE A2.2

Injury Definitions of Comparative Data Sources

Organization	Definitions	Comment
NEB	Under the SPI Initiative: "Any occupational injury that prevents an employee from reporting for work or from effectively performing all the duties connected with the employee's regular work on any day subsequent to the day on which the injury occurred, whether or not that subsequent day is a working day for the employee." (Canada Occupational Health and Safety Regulations Part XV, section 15.1(a)) Under the OPR-99: "serious injury" includes an injury that results in: the fracture of a major bone; the amputation of a body part; the loss of sight in one or both eyes; internal hemorrhage; third degree burns; unconsciousness; or the loss of a body part or function of a body part.	Guidance provided to companies by the NEB: "medical aid where the employee can not return to work the following day regardless of the day of the week or injury".
COGOA	Data represents "lost time injuries" which prevent an employee from reporting for work or from effectively performing all the duties connected with the employee's regular work on any day subsequent to the day on which the injury occurred, whether or not that subsequent day is a working day for the employee.	The definition is identical to the definition used by the NEB for the SPI Initiative.
HRSDC	Disabling Injury: "Any occupational injury that: a) prevents an employee from reporting for work or from effectively performing all the duties connected with the employee's work on any day subsequent to the day on which the occupational injury occurred, whether or not that subsequent day is a working day for that employee; b) results in the loss by an employee of a body member or a part thereof or in a complete loss of the usefulness of a body member or part thereof; or c) results in the permanent impairment of a body function of an employee." Disabling injury incidence: Disabling plus fatal injuries.	The definition is similar to the combined definition under the NEB OPR-99 and SPI Initiative.

TABLE A2.2 (CONTINUED)

Injury Definitions of Comparative Data Sources

CAPP	Any cut, fracture, sprain, amputation, loss of consciousness, etc, which results from an exposure involving a single event in the work environment.. Lost Time injuries – include fatalities, permanent total disabilities and lost workday cases resulting from work-related injuries. Recordable injuries – include fatalities plus permanent total disability plus lost workday cases plus restricted work cases plus medical treatment cases. Lost Workday Cases (LWC) – lost workday cases are work-related injuries, which render the injured person temporarily unable to perform any regular job or restricted work activity on any normally scheduled workday after the day on which the injury occurred. Restricted Work Cases (RWC) – a work-related injury or illness which results in an individual being unable to perform all normally assigned work functions during any scheduled work shift; or being assigned to another job on a temporary or permanent basis after the day of the injury or illness.	CAPP members are primarily upstream oil and gas companies and data may not be directly comparable to pipeline transmission companies.
PLCAC	Any work related personal injury or illness that results in time lost from work. Time lost begins on the day subsequent to the day the accident occurs.	PLCAC data does not include non-union pipeline contractor data. Mainline construction data should be roughly comparable to contractor data under the SPI Initiative.
BLS	Data presented is taken from industry classification for "Heavy construction, except highway - 162" and from "Gas production and distribution - 492" for injuries resulting in "days away from work, days of restricted work activity, or both for the years 2000 to 2002" Industry classifications changed in 2003. Data presented for 2003 to 2005 is taken from industry classification for "Utility System Construction - 2371" and from "Pipeline Transportation - 486" for injuries resulting in "days away from work, days of restricted work activity, or both"	Heavy construction and Utility System construction data should be roughly comparable to NEB contractor data. Gas production and distribution data and pipeline transportation data should be comparable to NEB company data.
OGP	Injury is referred to as a Lost Workday Case (LWDC) and Restricted Workday Case (RWDC). Any work related injury other than a fatal injury which results in a person being unfit for work or severe enough to prevent a person from performing normal duties on any day after the day of occurrence of the occupational injury. "Any day" includes rest days, weekend days, leave days, public holidays or days after ceasing employment.	

TABLE A2.3

Comparison of Liquid Release Reporting Criteria

Source	Reporting Requirements
NEB	Any unintended or uncontained release of liquid hydrocarbons associated with pipe body failure and a release volume in excess of 1.5 cubic metres.
ERCB	When a leak or break occurs in a pipeline, the licensee shall immediately cause the Board to be informed of the location of the leak or break. "Leak" means the escape of substance from a pipeline. "Break" means a rupture in any part of a pipeline.
CAPP	A pipeline rupture is defined as "any tearing or fracturing of pipeline material, immediately impairing the operation of the pipeline" [CAPP, 2007] A pipeline leak is defined as "any opening, crack or hole in the pipeline causing some product loss, but not immediately impairing the line's operation" [CAPP, 2007]
PHMSA	Loss of 8 or more cubic metres or where property damage costs exceeds $50,000 USD. After 7 February 2002: a release of 5 gallons (19 litres) or more.
CONCAWE	The minimum spill size has been set at 1 m^3 for reporting purposes unless there are exceptional serious safety / environmental consequences as a result of a <1m^3 spill.

TABLE A2.4

Comparison of Gas Release Reporting Criteria

Source	Reporting Requirements
NEB	Any unintended or uncontrolled release of natural gas.
PHMSA	Gas releases associated with a death or personal injury requiring hospitalization, or a total cost of $50,000 (U.S.) or more.
EGIG	Any unintentional release of gas which occurs on an onshore pipeline operating at greater than 1500 kPa outside of the fenced boundaries of installations and excluding all components except the pipe.

A3 Raw Data

Data for the period 1 January 2006 to 31 December 2006 was submitted voluntarily to the Board from companies owning or operating approximately 98% of the total length of pipelines regulated by the NEB under the *National Energy Board Act*. Companies typically report on all NEB-regulated pipelines systems that they own.

Reporting Companies for 2006:

Alliance Pipeline Ltd.
AltaGas Pipeline Partnership
ARC Resources Ltd.
Berens Energy Ltd.
BP Canada Energy Company
Canadian Montana Pipeline Company
Canadian Natural Resources Limited
Corporation Champion Pipeline
Enbridge Inc.
EnCana Corporation
ExxonMobil Canada Ltd.
Harvest Operations Corp.
Husky Oil Limited
Kinder Morgan Canada Inc.
Montreal Pipe Line Limited
Nexen Inc.
NuVista Energy Ltd.
Omimex Canada Ltd.
Pengrowth Corporation
PennWest Petroleum
Pioneer Natural Resources Canada Inc.
Sierra Production Company
Spectra Energy Gas Transmission
St. Clair Pipelines Inc.
Terasen Gas Inc.
TransCanada PipeLines Limited
Trans-Northern Pipelines Inc.
True Energy Trust
Union Gas Limited
Vector Pipeline Limited Partnership

The length of pipelines reported upon is provided in Table A3.1.

TABLE A3.1

NEB-Regulated Pipeline Statistics

Year	Number of Kilometres Reported Upon	Total Kilometres
2000	39 190	42 919
2001	42 670	42 968
2002	41 555	43 124
2003	42 189	43 252
2004	41 386	43 371
2005	41 270	43 440
2006	43 610	44 500

The raw data used to calculate the injury frequencies of NEB-regulated pipelines is presented in Table A3.2.

TABLE A3.2

NEB Injury Frequency Data

Year	Contractor Hours	Employee Hours	Contractor Injuries	Employee Injuries
2000	6 255 390	7 034 954	55	6
2001	1 606 271	4 827 678	40	18
2002	1 357 577	5 103 983	13	4
2003	788 466	4 869 253	12	16
2004	1 573 743	4 722 044	9	12
2005	1 218 350	4 925 620	7	15
2006	2 140 650	3 811 330	28	29

Year	Liquid Pipeline	Gas Pipeline	Total
2000	1 124 735	12 165 609	13 290 344
2001	1 808 947	4 625 003	6 433 950
2002	1 822 637	4 638 923	6 461 560
2003	1 655 670	4 002 049	5 657 719
2004	1 615 406	4 680 381	6 295 787
2005	1 398 649	4 745 321	6 143 969
2006	1 625 244	4 326 736	5 951 979

Table A3.3 provides comparative pipeline length data for the reference organizations cited within this report.

TABLE A3.3

Reference Organization Statistics

Year	Organization	Kilometres of Gas Pipeline	Kilometres of Hydrocarbon Liquid Pipeline	Total Reported Kilometres
2000	NEB	25 970	13 220	39 190
2000	ERCB	229 034	16 410	245 444
2000	CAPP	not available	not available	175 646
2000	PHMSA	524 000	249 020	773 020
2000	EGIG	110 236	0	110 236
2000	CONCAWE	0	30 800	30 800
2001	NEB	26 510	16 170	42 680
2001	ERCB	245 466	16 818	262 284
2001	CAPP	not available	not available	182 818
2001	PHMSA	479 800	255 060	734 860
2001	EGIG	110 236	0	110 236
2001	CONCAWE	0	35 575	35 575
2002	NEB	26 752	14 803	41 555
2002	ERCB	255 032	17 118	272 150
2002	CAPP	not available	not available	225 482
2002	PHMSA	526 007	258 409	784 899
2002	EGIG	109 524	0	109 524
2002	CONCAWE	0	35 592	35 592
2003	NEB	26 943	15 245	42 189
2003	ERCB	268 549	17 391	285 940
2003	CAPP	not available	not available	266 356
2003	PHMSA	522 020	258 892	780 912
2003	EGIG	114 285	0	114 285
2003	CONCAWE	0	36 422	36 422
2004	NEB	27 146	14 812	41 958
2004	ERCB	288 388	17 793	306 181
2004	CAPP	not available	not available	272 221
2004	PHMSA	518 283	270 262	788 545
2004	EGIG	122 168	0	122 168
2004	CONCAWE	0	35,383	35 383
2005	NEB	27 002	14 269	41 270
2005	ERCB	305 274	18 019	323 534
2005	CAPP	not available	not available	309 391
2005	PHMSA	522 960	266 493	789 452
2005	EGIG	not available	not available	not available
2005	CONCAWE	not available	not available	not available
2006	NEB	28 080	15 530	43 610
2006	ERCB	32 1940	18 140	340 086
2006	CAPP	not available	not available	not available
2006	PHMSA	515 108	264 935	780 043
2006	EGIG	not available	not available	not available
2006	CONCAWE	not available	not available	not available

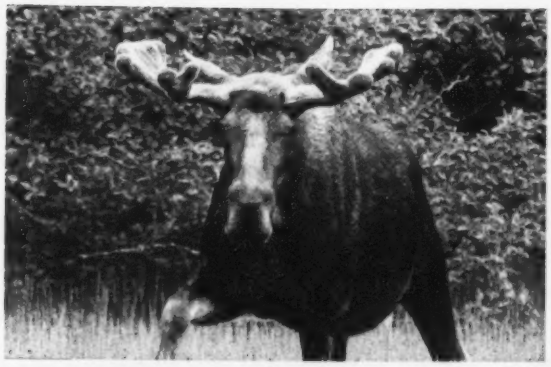
Comparative data is listed by source organization in Table A3.4.

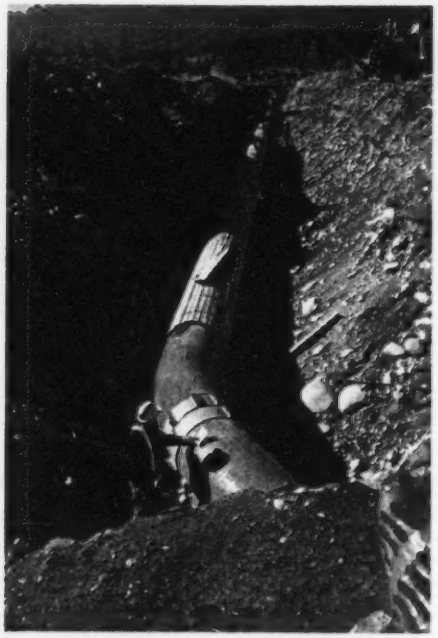
TABLE A3.4

Injury Frequency Data (Number of Injuries per 200,000 Hours Worked)

Year	Source*	Contractor Injury Frequency	Employee Injury Frequency	Overall
2000	NEB	1.76	0.17	0.92
2000	COGOA	not available	not available	1.06
2000	HRSDC	not available	0.51	not available
2000	CAPP	3.13	1.05	2.49
2000	PLCAC	2.88	not available	not available
2000	BLS	3.60	not available	not available
2000	OGP	0.47	0.31	0.41
2001	NEB	4.98	0.75	1.80
2001	COGOA	not available	not available	0.52
2001	HRSDC	not available	0.56	not available
2001	CAPP	2.61	0.89	2.06
2001	PLCAC	1.25	not available	not available
2001	BLS	3.90	not available	not available
2001	OGP	0.38	0.31	0.36
2002	NEB	1.92	0.16	0.53
2002	COGOA	not available	not available	0.56
2002	HRSDC	not available	0.30	not available
2002	CAPP	1.86	1.02	1.64
2002	PLCAC	1.72	not available	not available
2002	BLS	3.50	not available	not available
2002	OGP	0.32	0.19	0.28
2003	NEB	3.04	0.66	0.99
2003	COGOA	not available	not available	0.40
2003	HRSDC	not available	0.33	not available
2003	CAPP	2.15	1.34	1.80
2003	PLCAC	0.00	not available	not available
2003	BLS	3.80	1.00	not available
2003	OGP	0.35	0.17	0.29
2004	NEB	1.14	0.51	0.67
2004	COGOA	n/a	n/a	0.46
2004	HRSDC	not available	0.42	not available
2004	CAPP	1.90	1.00	1.64
2004	PLCAC	0.00	not available	not available
2004	BLS	3.20	1.40	not available
2004	OGP	0.31	0.20	0.28
2005	NEB	1.15	0.61	0.72
2005	COGOA	not available	not available	0.54
2005	HRSDC	not available	0.32	not available
2005	CAPP	1.74	0.95	1.52
2005	PLCAC	0.00	not available	not available
2005	BLS	3.20	0.90	not available
2005	OGP	0.31	0.17	0.27
2006	NEB	1.59	1.52	1.55
2006	COGOA	not available	not available	0.25
2006	HRSDC	not available	not available	not available
2006	CAPP	1.74	0.83	1.48
2006	PLCAC	0.56	not available	not available
2006	BLS	3.10	0.90	not available
2006	OGP	0.30	0.19	0.27

* CAPP data is for Total Recordable Injury Frequency and includes fatalities and medical treatment cases, which are not included in the NEB data.





GOALS 1 AND 2

NEB-regulated facilities and activities are safe and secure, and are perceived to be so.

NEB-regulated facilities are built and operated in a manner that protects the environment and respects the rights of those affected.